Scheme and Syllabus
for

Post Graduate Programme

in

M. Tech. (Transportation Engineering)

Department of Civil Engineering
Malaviya National Institute of Technology Jaipur
Jaipur, Rajasthan- 302017
August 2021

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Institute Vision:

To create a centre for imparting technical education of international standards and conduct research at the cutting edge of technology to meet the current and future challenges of technological development.

Institute Mission:

To create technical manpower for meeting the current and future demands of industry: To recognize education and research in close interaction with industry with emphasis on the development of leadership qualities in the young men and women entering the portals of the Institute with sensitivity to social development and eye for opportunities for growth in the international perspective.

DEPARTMENT OF CIVIL ENGINEERING

Vision:

To serve the nation by providing high quality engineering education that enables students to get a profession that can improve the civil infrastructure and social welfare.

Mission:

To create an environment conducive for excellent teaching, learning and research in order to produce leading entrepreneurs and innovators in the field of civil engineering for sustainable development.

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Master of Technology – Transportation Engineering

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PEO1: To provide skilled personnel with integrated learning of planning, design, construction, maintenance, upgradation, and operation of the highways/transportation infrastructure for sustainable future aspects.

PEO2: To provide students a solid foundation in mathematical, scientific and engineering fundamentals required to formulate, analyse and solve transportation engineering related problems and develop innovative capability using modern equipment's and latest software.

PEO3: To provide an academic ambience that allows students to develop research aptitude to enable them for providing sustainable and cost-efficient/innovative solutions to society.

PEO4: To inculcate in students, the professional and ethical attitude, teamwork skills, multidisciplinary approach, and an ability to engage in independent and life-long learning.

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PROGRAM OUTCOMES (PO)

A student who has met the objectives of the program will possess:

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate a degree of mastery over transportation engineering at a level higher than the requirements in the appropriate bachelor's program

PO4: An ability to understand Subgrade material, transport planning, flexible & rigid pavement construction, testing of different materials and mix designs.

PO5: An ability to design retaining structures, intersections, pavements & overlays, and carry out maintenance & safety audit.

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DEPARTMENT OF CIVIL ENGINEERING

M.Tech. (Transportation Engineering)

Semester I

S. No	Course Code	Course Title	Course Category	Type	Credit	L	T	P
1.	21CET561	Highway Materials	Program Core	Theory	3	3	0	0
2.	21CET562	Mathematics for Transportation Engineering	Program Core	Theory	3	3	0	0
3.	21CET563	Pavement Analysis & Design	Program Core	Theory	3	3	0	0
4.	CEPxxx	Elective 1 (Lab Course)	Program Elective	Practical	1	0	0	2
5.	CEPxxx	Elective 2 (Lab Course)	Program Elective	Practical	1	0	0	2
6	CETxxx	Elective 3	Program Elective	Theory	3	3	0	0
7	CETxxx	Elective 4	Program Elective	Theory	3	3	0	0
				Total Semester Credits	**17**			

Semester II

S. No	Course Code	Course Title	Course Category	Type	Credit	L	T	P
1.	21CET564	Highway Sub-Grade andFoundation Analysis	Program Core	Theory	3	3	0	0
2.	21CET565	Intersection Analysis andDesign	Program Core	Theory	3	3	0	0
3.	21CET566	Transportation Planning	Program Core	Theory	3	3	0	0
4.	CETxxx	Elective 5	Program Elective	Theory	3	3	0	0
5.	CETxxx	Elective 6	Program Elective	Theory	3	3	0	0
6.	CETxxx	Elective 7	Program Elective	Theory	3	3	0	0
				Total Semester Credits	**18**			

Semester III

S. No	Course Code	Course Title	Course Category	Type	Credit	L	T	P
1.	21CES662	Seminar/Minor Research Project	Program Core	Seminar	4	---	---	8
2.	21CED661	Dissertation	Program Core	Dissertation	8	---	---	16
				Total Semester Credits	**12**			

Semester IV

S. No	Course Code	Course Title	Course Category	Type	Credit	L	T	P
1.	21CED663	Dissertation	Program Core	Dissertation	12	---	---	24
				Total Semester Credits	**12**			
				Total Credits of all Semesters	**59**			

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List of Program Electives (PE)

S.No.	Course Code	Course Title	Course Category	Type	Credit	L	T	P
1.	21CET833	Highway Construction	Elective	Theory	3	3	0	0
2.	21CEP834	Highway Material Testing Laboratory	Elective	Practical	1	0	0	2
3.	21CET835	Low Cost Roads	Elective	Theory	3	3	0	0
4.	21CET836	Pavement Maintenance Management System	Elective	Theory	3	3	0	0
5.	21CET837	Traffic and Environment	Elective	Theory	3	3	0	0
6.	21CET838	Traffic Engineering & Field Studies	Elective	Theory	3	3	0	0
7.	21CEP839	Traffic Engineering Lab	Elective	Practical	1	0	0	2
8.	21CET840	Traffic Flow Modeling and Simulation	Elective	Theory	3	3	0	0
9.	21CET841	Urban Transportation System	Elective	Theory	3	3	0	0

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Department/Center	**:**	**Department of Civil Engineering**
M.Tech.	**:**	**Transportation Engineering**
Course Code	**:**	**21CET561**
Course Name	**:**	**Highway Materials**
Credits	**:**	**3 L - 3 T - 0 P - 0**
Course Type	**:**	**Core**
Prerequisites	**:**	**None**

COURSE OUTCOMES

CO1: Able to understand soil as road foundation material, its classification and stabilization

CO2: Able to understand Natural and Artificial aggregate material, classification, properties, testing, mixes and modifications

CO3: Able to understand bitumen, tar, cutback, emulsions, properties, testing and modified bitumen

CO4: Able to understand Cement Concrete material, properties, testing, mix design.

COURSE CONTENTS

Soil: classification, nomenclature, desirable properties, laboratory and field test, IRC/MORT&H standards, materials for low-cost roads, stabilized soil, lime, fly ash, and cement and soil-bitumen stabilization.

Aggregate: classification, gradation, physical properties test, soil-aggregate and aggregate bitumen mixes, sub base, base and wearing course materials, quality manufacture of aggregates with respect to IRC/MORT&H specifications (clause 400) BM, soft aggregates, artificial aggregates, industrial waste as road aggregate, blending of aggregate by triangular chart, trial and error proportioning methods.

Bitumen: origin, extraction, physical properties test, various terms related to tar and bitumen, uses and application of different bituminous material in highway construction, bitumen chemistry, constituents structure, ageing, rheology of bituminous binders, Adhesion, failures, weathering of bituminous road materials, bituminous mixes, requirements of bituminous mixes, Marshall and other methods of bituminous mix design, IRC/ MORT&H specifications (clause 500), bitumen modification.

Cement: constituents, environmental issues concrete, properties of cement in fresh and hardened state, test methods, durability properties, mineral admixtures, material specifications, Concrete Mix Design.

Recommended Readings

Text /Reference books:-

1. Highway Engineering: S.K. Khanna & C.E.G. Justo, 10th Edition Nem Chand & Bros, Roorkee
2. Concrete Technology: Theory and Practice M. S. Shetty & A K Jain S. Chand Publishing
3. Concrete Technology: A.M. Neville, J J Brooks, second edition 2010
4. Asphalt Institute. Asphalt Mix Design Methods, Manual Series No. 2 (MS-2), Seventh Edition, Asphalt Institute, Kentucky, USA.
5. RRL, DSIR, Soil Mechanics for Road Engineers, HMSO, London, 1995
6. IS: 10262, 2019 Guidelines for concrete mix design proportioning
7. MORTH Specifications for Road and Bridge Works, 5th revision Ministry of Road Transport & Highways 2013
8. All material test specifications as per relevant Indian or foreign standards

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Department/Center	**:**	**Department of Civil Engineering**
M.Tech.	**:**	**Transportation Engineering**
Course Code	**:**	**21CET562**
Course Name	**:**	**Mathematics for Transportation Engineering**
Credits	**:**	**3 L - 3 T - 0 P - 0**
Course Type	**:**	**Core**
Prerequisites	**:**	**None**

COURSE OUTCOMES

CO1: Recognize and apply appropriate theories, principles and concepts relevant to Numerical Analysis for solution of Civil Engineering problems.

CO2: Analyse the computational methods for advantages and drawbacks and choose the suitable computational method among several existing methods for solution of day-to-day civil engineering problems.

CO3: Application of Numerical differentiation and Integration for derivation of FDM and Time-marching Schemes for solution of problems such as beams on elastic foundation, consolidation.

CO4: Different approaches to solution of global element matrix used in the FEM for complex Civil engineering problems.

COURSE CONTENTS

Introduction, roots of a non-linear equation and roots of a polynomial of nth degree by different methods and convergence study. Solution of (non-homogeneous) linear algebraic equations, review of matrix algebra, Gauss elimination method, Cholesky's decomposition method, householder method, Gauss-Siedal iterative method. Solution of non-linear algebraic equations, method of successive approximation, Newton's method, modified Newton – Raphson method, secant method.

Eigen values and Eigen vectors, reduction of generalized Eigen value problem to the standard Eigen value problem, methods for obtaining Eigen values and Eigen vectors [polynomial method, vector iteration method, Mises power method, Jacobi method]

Numerical differentiation and integration- Simpsons one-third, Simpsons three- eighth and trapezoidal rules. Time marching schemes for solution of problems in time domain, numerical integration (2 – D) [Newton – Cotes method, Gauss – Legendre method]

Solution of ordinary and partial differential equations, Euler's method, Runge – Kutta method, finite difference method, applications to problems of beam and plates on elastic foundation, consolidation equation, laterally loaded piles etc.

Recommended Readings

Text /Reference books:-

1. Advanced Engineering Mathematics, Kreyzig, 2015
2. Numerical Methods for Engineers, Chapra, S. C. and Canale R. P., Tata Mcgraw Hill; fourth edition, 2002
3. Applied Numerical Methods, Carnahan, B., Luther, H. A. and Wilkes, J. O., John Wiley, 1969
4. Numerical Analysis, Douglas Faires, J. and Richard Burden, Thomson, 2002

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Department/Center	**:**	**Department of Civil Engineering**
M.Tech.	**:**	**Transportation Engineering**
Course Code	**:**	**21CET563**
Course Name	**:**	**Pavement Analysis and Design**
Credits	**:**	**3 L - 3 T - 0 P - 0**
Course Type	**:**	**Core**
Prerequisites	**:**	**None**

COURSE OUTCOMES

CO1: Students can understand and recognize the components of pavement structure.

CO2: To make students acquainted with various type of pavement and their analysis.

CO3: Enable them to design pavement for various requirements

CO4: They should be able to analyse their failure cracks and other defects and probable reason for them.

CO5: They must acquire knowledge about pavement overlays**.**

COURSE CONTENTS

Components of pavement structure, importance of sub-grade soil properties on Pavement performance. Functions of sub-grade, sub-base, base course and Wearing course. Effects of dual wheels and tandem axles, area of contact, tire pressure, CBR value of different layers, design methods for flexible pavement: sustainable cost-effective options for roads.

Elements in design of rigid pavements: Wheel load, stresses, basic properties of concrete elasticity, shrinkage & creep, durability of Concrete, dry lean concrete, rigid pavement design, concrete mix design, admixture.

Temperature stresses: Effect of temperature variations on concrete pavements. Combination of stresses due to different causes,

Types of distress: structural and functional, serviceability, fatigue cracking, pavement deformation and low temperature shrinkage cracking, factors affecting performance.

Pavement overlays: Flexible overlays and Rigid overlays. Micro surfacing, gap grading, cold mixes using emulsion and foam Bitumen etc. recycled material.

Recommended Readings

Text /Reference books:-

2. Yoder, E.J. and M.W. Witczak Principles of Pavement Design, Second Edition, John Wiley and Sons, New York, USA, 1991.
3. Concrete Roads: HMSO.
4. Pavement systems management: Haas & Hudson.
5. Pavement Analysis & Design: Huang.
6. Das, A. Analysis of Pavement Structures, CRC Press, Taylor and Francis Group, Florida, USA, 2015.

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Department/Center	**:**	**Department of Civil Engineering**
M.Tech.	**:**	**Transportation Engineering**
Course Code	**:**	**21CET564**
Course Name	**:**	**Highway Subgrade and Foundation Analysis**
Credits	**:**	**3 L - 3 T - 0 P - 0**
Course Type	**:**	**Core**
Prerequisites	**:**	**None**

COURSE OUTCOMES

CO1: Ascertain the behaviour of Soil as a construction material or supporting medium for Civil Engineering structures.
CO2: Analyse distress/failure condition relating to Soil/foundation and hence to suggest remedial measures
CO3: Evaluate Strength of Subgrade soil.
CO4: Impart the knowledge of geosynthetics and various soil stabilization method and analysis and design of sheet pile and braced cuts.

COURSE CONTENTS

Sub-Grade: Importance, properties & functions. Soil survey: procedure for highways and ground water investigations. Soil classification for highway engineering purpose – Casagrande, U.S.P.R.A., Unified, CAA, HRB, FAA.

Effects of water in soil–swelling shrinkage, soil suction. Sub soil drainage: General principles, elementary groundwater hydrology, control of high-water table and seepage flow, Frost action in soils.

Compressibility: Compaction of soil, field and laboratory methods, equipment, field control, sub-grade and embankment compaction. Consolidation, Vertical Sand Drains: Design criteria, construction and uses. Stress-strain relationship in soils. Stress history, Anisotropy, Critical state model, stress paths.

Strength Evaluation of subgrade soils, Laboratory tests - Direct shear test, UCC test, CBR test, Triaxial test, Field tests-Co-efficient of subgrade reaction, Field CBR, North Dakota Cone test.

Foundation: methods of reducing settlements, consolidation of compressible soils estimation of rate of settlement due to consolidation in foundation of road embankments. Construction of high embankments over weak foundations. Various methods of excavation displacement of soft and swampy soil for the construction of embankments. Soil Stabilization: use of lime, cement, bitumen and other commercial stabilizers. Applications of geo-synthetics in pavements.

Recommended Readings

Text /Reference books

1. Basic and Applied Soil Mechanics, Gopal Ranjan, New Age International Publisher, 2016
2. Soil Mechanics for Road Engineers: HMSO.
3. Soil Mechanics in Road Construction, Armstrong C. F. Edward Arnold London, 1950
4. Soil Mechanics and Foundation Engineering, Murthy, CBS Publishers & Distributors, 2018

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Department/Center	**:**	**Department of Civil Engineering**
M.Tech.	**:**	**Transportation Engineering**
Course Code	**:**	**21CET565**
Course Name	**:**	**Intersection Analysis and Design**
Credits	**:**	**3 L - 3 T - 0 P - 0**
Course Type	**:**	**Core**
Prerequisites	**:**	**None**

COURSE OUTCOMES

CO1: Understand the types of Intersections and factors affecting the design
CO2: Knowledge about importance of conflict points and how to reduce them under different circumstances
CO3: Analyse the traffic survey data for intersections and know its capacity
CO4: Design speed change lanes and median lanes
CO5: Acquaint with design of signals and analysis and features to be provided at intersections

COURSE CONTENTS

Type of intersection, general considerations for the location of various intersection types, principles of intersection design, types of maneuvers, relative speed, conflict points and areas, design surveys for intersection, intersection geometrics for various types including approach and exit details.
Capacity and performance analysis of various types of intersections for various types of operation-capacity level of service, intersection delay, uncontrolled priority controlled and roundabout intersection- their capacity and delay analysis, and overall design.
Design and operational evaluation of weaving sections. Design of speed change lanes and median lanes. Grade separated intersection and interchanges-types, suitability and economic justifications.
Design of intersection controls-signalization design and analysis, turn control, general traffic control by islands, pedestrian control, signs, markings, intersections lighting etc.
Road Safety Audit – Introduction, Case studies.

Recommended Readings

Text /Reference books

1. IRC SP 41- 2015: Guideline for design of at grade intersection
2. IRC 67-2105: Code of practice for road signs
3. IRC 92-2017: Guideline of design of interchange in urban area
4. IRC 93-2017: Guideline on design and installation of road traffic signal
5. L.R. Kadiyali, Traffic Engineering and Transportation Planning, Khanna Publishers, 2011.
6. Khistry C.J., “Transportation Engineering, an Introduction”, Prentice Hall, New Jersey, 1990.
7. Transportation Research Board, “Highway Capacity Manual”, SR-209, TRB, 1985, 1994.

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Department/Center	**:**	**Department of Civil Engineering**
M.Tech.	**:**	**Transportation Engineering**
Course Code	**:**	**21CET566**
Course Name	**:**	**Transportation Planning**
Credits	**:**	**3 L - 3 T - 0 P - 0**
Course Type	**:**	**Core**
Prerequisites	**:**	**None**

COURSE OUTCOMES

CO1: Ability to understand scope, concept and processes of transportation planning & sustainable transportation system.
CO2: Analyse and understand various road modals.
CO3: Ability to analyse trip distribution methods, various land use models and their use in transportation planning.
CO4: An ability to analyse Transportation modelling and development work to solve practical problems.
CO5: Gain knowledge about transportation analysis zone design, route planning and their implementation for estimation & forecasting.

COURSE CONTENTS

Transportation planning methodology, hierarchical levels of planning-statewide, regional, urban passenger and goods transportation. General concept and process of transportation planning. Urbantransportation planning, urban travel characteristics: private and public, travel behavior analysis. Travel demand estimation and forecasting. Transportation Analysis Zone Design; Travel demand Analysis; Land use – Transportation Modelling; Route Planning; Decision support for Transportation Planning.
Trip classification and socio-economic variable in trip making, trip generation; multiple regression analysis, category analysis, comparative study. Modal split analysis- traditional analysis, behavioralapproach to mode choice, two-stage modal split models.
Trip distribution: Growth factor method, gravity model. Intervening opportunity and competing opportunity models, comparative study. Traffic assignment network assignment, capacity restrained.Land-use transport planning: Land-use transport intersections, transport related land use models and their use in transportation planning.

Recommended Readings

Text /Reference books:-

1. C A O'Flaherty, ed, "Transport Planning and Traffic Engineering", Butterworth Heinemann, Elsevier, Burlington, MA 2006
2. C JotinKhisty and B Kent Lall, "Transportation Engineering – An Introduction", Prentice Hall of India Pvt Ltd., New Delhi 2003
3. Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna publishers, 2007
4. Vinay Maitri and P.K Sarkar, Theory and Applications of Economics in Highway and Transport Planning, Standard Publishers Distributors, First Edition 2010.
5. Geetam Tiwari and Dinesh Mohan, Transport Planning and Traffic Safety: Making Cities, Roads, and Vehicles Safer, CRC Press, 2016.

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Department/Center	**:**	**Department of Civil Engineering**
M.Tech.	**:**	**Transportation Engineering**
Course Code	**:**	**21CET833**
Course Name	**:**	**Highway Construction**
Credits	**:**	**3 L - 3 T - 0 P - 0**
Course Type	**:**	**Elective**
Prerequisites	**:**	**None**

COURSE OUTCOMES

CO1: To understand construction procedure of Subgrade layer of pavement

CO2: Detailed construction procedure of highway construction of different types of Base Course

CO3: Knowledge of the different type of bitumen mixes & Concrete mixes in Highway Construction and their testing

CO4: Analysis of different types of Joints, IRC specifications, Reinforced Cement Concrete Road Construction.

COURSE CONTENTS

Classification of types of highway construction, Suitability of each type under Indian conditions, selection of base course and surface course. Earth work & Soiling: Selection of soils, construction of embankments, excavation and compaction equipment's. Field and laboratory tests for quality control. Stone soiling, brick soiling, current practices.

Construction of earth roads, gravel roads, soil stabilized roads; water bound macadam, paved roads, bricks, stones. Bituminous construction: properties, requirements and specifications of materials, equipment's and plants. Detailed construction procedure of each type. Field and laboratory tests for quality control. Choice of binders under different conditions. IRC and MORTH specifications.

Recommendations under Indian conditions: Bituminous surface treatments, interface treatments – prime-coat and tack-coat, surface dressing and sealcoat, grouted or penetration macadam, bituminous bound macadam, bituminous concrete, mastic asphalt. Cement Concrete Road Construction: Necessity of providing a base course under cement concrete road. Selection of materials, construction methods, Quality control tests (lab. and field), Construction equipment's.

Joints in cement concrete pavements: Classification of various types of joints, necessity, method of construction, load transfer devices, dowel bars, tie bars. Joint filler and sealer materials, IRC specifications. Reinforced Cement Concrete Road Construction:

Recommended Readings

Text /Reference books:-

1. Highway Construction and Maintenance: Watson
2. Highway design and construction: Bruce and Clarkeson
3. Highway Engineering: S.K. Khanna & C.E.G. Justo, 10th Edition Nem Chand & Bros, Roorkee
4. IRC: 37-2018 Guidelines for the Design of Flexible Pavements, The Indian Roads Congress, New Delhi.
5. IRC:58-2015 Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, The Indian Roads Congress, New Delhi.
6. MORTH Specifications for Road and Bridge Works, 5th revision Ministry of Road Transport & Highways 2013, The Indian Roads Congress, New Delhi.

Department/Center : Department of Civil Engineering

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M.Tech.	**:**	**Transportation Engineering**
Course Code	**:**	**21CET834**
Course Name	**:**	**Highway Material Testing Laboratory**
Credits	**:**	**1 L - 0 T - 0 P - 2**
Course Type	**:**	**Elective**
Prerequisites	**:**	**None**

COURSE OUTCOMES

CO1: Able to understand soil as road foundation material, its classification and testing

CO2: Ability to understand Natural and artificial aggregate material, classification, properties, testing, mixes and gradation

CO3: Able to understand Bitumen, their properties, testing and significance

CO4: Able to understand Cement and Concrete material, Properties, testing and mix design

COURSE CONTENTS

Soil Testing: Particle size analysis, liquid limit, plastic limit, maximum dry density, California bearing ratio, In situ density test.
Aggregates Testing: Particle size analysis, GSB gradation, impact, abrasion, crushing, stripping value, water absorption, flakiness and elongation Index, specific gravity (coarse, fine, filler).
Bitumen Testing: Penetration, ductility, viscosity, softening point, flash - fire point, specific gravity, bituminous mix designs (BM/ DBM/ BC), test on mixes stability, volumetric ratios, indirect tensile strength, bitumen extraction.
Cement Testing: Fineness, consistency, initial and final setting time, compressive strength, specificgravity, soundness, concrete mix design, concrete consistency, compaction factor, compressive, flexural, strength, permeability, carbonation, chloride penetration, acid attack.

Recommended Readings

Text /Reference books:-

1. Highway Engineering Lab. Manual: S.K. Khanna, C.E.G. Justo & S.S Jain, Nem Chand & Bros, Roorkee
2. IRC and IS specifications for material testing.
3. Ministry of Road Transport and Highways. Specifications for Road and Bridge Works, Fifth Edition, Indian Roads Congress, New Delhi, India, 2013.
4. IS 10262-2019 Guidelines for Cement Concrete Mix Design for Pavements, the Indian Roads Congress,New Delhi, India.

Department/Center	**:**	**Department of Civil Engineering**

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M.Tech.	**:**	**Transportation Engineering**
Course Code	**:**	**21CET835**
Course Name	**:**	**Low Cost Roads**
Credits	**:**	**3 L - 3 T - 0 P - 0**
Course Type	**:**	**Elective**
Prerequisites	**:**	**None**

COURSE OUTCOMES

CO1: Ability to know about concept, objective and scope of low cost and rural roads and Core Network, Detailed Project Report (DPR) and it's importance in India
CO2: To know about rural road geometrics, design of flexible and rigid pavement as per IRC guidelines
CO3: Ability to design surface and sub surface drainage, types, side drains and cross drainage works
CO4: To be able to maintenance of rural roads.

COURSE CONTENTS

History, concept objective, scope and coverage of low cost and rural roads. Core network, detail project report (DPR), master plan, rural road investment, significance of low-cost roads for developing, countries, with special reference to India.

Rural roads vision 2025, features of PMGSY, development of LCRs in India, master plan and core network concepts, concepts of network planning of LVRs, System's Approach.

Socio-economic and environmental aspects, Stage construction, Rural road geometrics, design elements, Low volume road design principles, flexible and rigid pavement design as per IRC guidelines., purpose of pavement, vehicle classifications, traffic volumes, equivalent standard axles per vehicle class, design traffic classes.

Surface and sub-surface drainage, importance, types, side drains, culverts, pavement layers and cross drainage works, Maintenance of rural roads.

Case studies of waste material utilization in rural roads, low cost, techniques for rural road construction, MoRD specifications for requirements of subgrade, road base, sub-base, quality control, failures and maintenance of low cost roads polices in Indian context.

Recommended Readings

Text /Reference books:-

1. IRC: SP: 72-2015 Guidelines for design of rural road flexible pavement.
2. IRC: SP: 62-2018 Guidelines for design of rural road rigid pavement.
3. IRC SP 20: Rural Road manual, Indian road congress, New Delhi, 2018.
4. MoRD, Specifications for Rural Roads, Ministry of Rural development (Fifth revision), Indian road congress, New Delhi,2014.
5. IRC: 73-2019 Guidelines for rural roads (non-urban) geometric design.
6. MORTH Specifications for Road and Bridge Works, 5th revision Ministry of Road Transport Highways 2013, The Indian Roads Congress, New Delhi.

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Department/Center	**:**	**Department of Civil Engineering**
M.Tech.	**:**	**Transportation Engineering**
Course Code	**:**	**21CET836**
Course Name	**:**	**Pavement Maintenance Management System**
Credits	**:**	**3 L - 3 T - 0 P - 0**
Course Type	**:**	**Elective**
Prerequisites	**:**	**None**

COURSE OUTCOMES

CO1: Ability to understand the various components of pavement management system and pavement maintenance management system.

CO2: To acquire knowledge about various maintenance measures

CO3: To understand structural requirement evaluation of flexible pavements and able to prioritize roads network system.

CO4: To know the concept of present serviceability index concepts (PSI).

COURSE CONTENTS

Introduction to Pavement Maintenance Management System, components of pavement management maintenance measures PMMS objectives.

Routine maintenance, periodic maintenance, special repairs, responsive maintenance programme, rehabilitation and reconstruction, treatment strategies and selection

Functional Evaluation of Pavements: Introduction, factors affecting pavement deterioration, functional condition evaluation techniques, roughness measurements, Identification of uniform sections, serviceability concepts, visual and ride rating techniques

Structural requirements and Evaluation of flexible pavements – Design requirements, Structural condition evaluation techniques, factors affecting structural condition of flexible pavements, structural behavior and evaluation of structural condition of pavements. NDT procedures, rebound deflection, deflection bowl measurement and analysis, IRC overlay design method, structural evaluation using falling weight deflectometer, back calculation of layer moduli, ground penetrating radar for pavement evaluation, evaluation of pavement safety: skid resistance and hydroplaning.

Design of overlays by Benkelman Beam Rebound Deflection Technique.

Pavement Serviceability concepts, Evaluation of riding quality by psychophysical method. Pavement Maintenance Measures, Implementation of Maintenance management programs.

Concept of HDM-IV

Recommended Readings

Text /Reference books:-

1. Pavement systems management: Haas & Hudson.
2. Bituminous Materials: HMSO
3. Haas, R., W.R. Hudson and J.P. Zaniewski. Modern Pavement Management, Krieger Publishing Company, Malabar, Florida, USA, 1994.
4. Mallick, R.B. and T. El-Korchi Pavement Engineering – Principles and Practice, CRC Press, Taylor and Francis Group, Florida, USA, 2009.
5. Ministry of Road Transport and Highways. Specifications for Road and Bridge Works, Fifth Edition, Indian Roads Congress, New Delhi, India, 2013.
6. Rajib B. Mallick and Tahar El-Korchi, Pavement Engineering: Principles and Practice, Second Edition, CRC Press, London, 2013

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Department/Center	**:**	**Department of Civil Engineering**
M.Tech.	**:**	**Transportation Engineering**
Course Code	**:**	**21CET837**
Course Name	**:**	**Traffic and Environment**
Credits	**:**	**3 L - 3 T - 0 P - 0**
Course Type	**:**	**Elective**
Prerequisites	**:**	**None**

COURSE OUTCOMES

CO1: To develop knowledge and skills for environmental monitoring on road projects.
CO2: To develop expertise in use of waste materials as low cost material and sustenance for road
CO3: To learn scope of environmental codal provisions in transportation and road sector.
CO4: To develop expertise to assess pollution abatement practices.

COURSE CONTENTS

Roads and environment: Impact and mitigation measures of air quality and noise due to traffic. Impact of transportation projects on water quality, flora and fauna.

Emission factors of vehicles and their determination: Air and noise quality measurement and indices related to highways. Modeling of air and noise pollution due to traffic. Effect of emissions on human health. EIA and SIA of transportation projects.

Mitigation Measures & Policies: Cleaner fuels, vehicle technology and replacement strategies, improving fuel efficiency, encouraging non-motorized and public transport, Taxation on emissions; Noise barriers, Land use planning, resurfacing roads with low- noise materials, Managing traffic flows, advanced construction methods.

Use of waste materials for road construction. Alternate fuels for transportation and their environmental effects. Emission control technologies.

Environmental Standards, Laws & Regulations: Laws concerned with protection of the environment such as Environmental Protection Act, Air and Noise Pollution Act, Motor Vehicle Act, Town and CountryPlanning Act, Development Control Regulation.

Recommended Readings

Text /Reference books:-

1. Air Pollution Modeling and Simulation: Bruno Sportisse
2. Traffic and Environment (Handbook of Environmental Chemistry): Dusan Gruden
3. Keith W. Little, Environmental Fate and Transport Analysis with Compartment Modeling, CRC Press, Taylor & Francis Group, 2012.
4. NCHRP Report 541. Consideration of Environmental Factors in Transportation Systems Planning, TRB, 2005.
5. Peter Morris and RikiTherivel, Methods of Environmental Impact Assessment (Natural and Built Environment Series), 3rd Edition, Routledge, 2009

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Center	**:**	**Department of Civil Engineering**
M.Tech.	**:**	**Transportation Engineering**
Course Code	**:**	**21CET838**
Course Name	**:**	**Traffic Engineering & Field Studies**
Credits	**:**	**3 L - 3 T - 0 P - 0**
Course Type	**:**	**Elective**
Prerequisites	**:**	**None**

COURSE OUTCOMES

CO1: Ability to understand scope of traffic engineering, road & vehicular characteristics.
CO2: Analyse and understand various traffic studies and traffic counts.
CO3: Ability to analyse traffic regulations and various means of traffic control, traffic islands, rotaries & signals.
CO4: An ability to independently carry out roadway lighting design layout and development work to solve practical problems.
CO5: An ability to understand road safety audit & the related case studies.

COURSE CONTENTS

Introduction: definitions and normal scope of study within traffic engineering. Traffic characteristic: Review of road user characteristics and vehicular characteristics.

Various traffic studies:

i. Spot speed studies - data analysis and interpretations
ii. Speed and delay studies- Purpose, course of delay, various methods of speed and delay studies.
iii. Traffic volume studies and characteristics
iv. Origin and destination studies: Various methods of O and D studies and sampling.
v. Traffic capacity studies- Volume and density relationships, critical density, basic, possible and practical capacities. Factors affecting possible and practical capacities.
vi. Parking studies and characteristics – Public interest in parking studies, cordon count, space inventory, parking practices. Evaluation of parking controls.
vii. Accident studies and characteristics – Course of accidents, accident studies and records, reports, application of accident studies, preventive measures. Traffic controls and operations,
    a. Traffic regulations and various means of traffic control, traffic islands, rotaries & signals.
    b. Traffic management- Techniques and applications.
    c. Roadway Lighting-Design and layout.

Road Safety Audit – Introduction, stages, Case studies.

Recommended Readings

Text /Reference books

1. Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna publishers, 2007.
2. Highway Engineering: S.K. Khanna & C.E.G. Justo, 10th Edition Nem Chand & Bros, Roorkee
3. The Institute of Transportation Engineers, Transportation and Traffic Engg. Hand Book, Prentice Hall (1982) Chapters 8, 17, 21, 23 and 24.
4. O'Flaherty C A, Highways- Traffic Planning & Engineering, Edward Arnold, UK, 2002
5. McShane W R &Roess R P, Traffic Engineering, Prentice-Hall, NJ, 2010
6. IRC 93-2017: Guideline on design and installation of road traffic signal
7. IRC: SP: 88-2010: - Road Safety Audit Manual.

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Center	**:**	**Department of Civil Engineering**
M.Tech.	**:**	**Transportation Engineering**
Course Code	**:**	**21CET839**
Course Name	**:**	**Traffic Engineering Lab.**
Credits	**:**	**1 L - 0 T - 0 P - 2**
Course Type	**:**	**Elective**
Prerequisites	**:**	**None**

COURSE OUTCOMES

CO1: Knowledge about traffic characteristics, road user and vehicle characteristics

CO2: Understanding the various traffic studies spot speed, speed and delay studies

CO3: Ability to understand objectives of traffic volume, origin and destination (O&D) and traffic capacity studies.

CO4: To acquaint with traffic control and regulation measures. Traffic management and roadway lighting.

COURSE CONTENTS

Tests using Driver Testing Unit, Origin & Destination Survey (license plate method of OD survey),Spot speed studies, Speed & Delay studies, Traffic Volume count, Turning Movement Counts (including on Intersections), Parking study, Parking usage survey, Capacity study etc.

Recommended Readings

Text /Reference books

1. L.R. Kadiyali, Traffic Engineering and Transportation Planning, Khanna Publishers, 2011.
2. Highway Engineering Lab. Manual: S.K. Khanna, C.E.G. Justo & S.S Jain, Nem Chand & Bros, Roorkee
3. Highway Engineering: S.K. Khanna & C.E.G. Justo, 10th Edition Nem Chand & Bros, Roorkee
4. IRC and IS specifications for Traffic Engineering.

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Center	:	**Department of Civil Engineering**
M.Tech.	:	**Transportation Engineering**
Course Code	:	**21CET840**
Course Name	:	**Traffic Flow Modeling and Simulation**
Credits	:	**3 L - 3 T - 0 P - 0**
Course Type	:	**Elective**
Prerequisites	:	**None**

COURSE OUTCOMES

CO1: Develop understanding about traffic flow characteristics and simulation models.
CO2: Learn to solve traffic problems such as pedestrian flow, signalized and unsignalized intersections.
CO3: Learn simulation languages.

COURSE CONTENTS

Traffic flow characteristics; Traffic flow modeling approaches, deterministic and stochastic models of stream flows; Car following models, stability and diffusion phenomena in traffic; Boltzmann models. Gas- kinematic models; Hybrid Simulation.

Signalized and un-signalized intersections, Coordination and optimization of network of signalized intersections; Gap acceptance models; Psychology and Traffic Control Interactions. Non-lane- b a s e d behavior modeling, multi-scale modeling approach, Picoscopic modeling.

Pedestrian Flow Modeling: Pedestrian behavior; Pedestrian interactions; Pedestrian facilities; Pedestrian behavioral models; Social-force models; Pedestrians simulation; Pedestrian stream models. Pedestrian flow problems

Simulation Methodologies: Monte Carlo method; Simulation methods; Fundamentals of simulation, Introduction to factorial experimental designs, Fractional factorial design, Components of traffic simulations models, vehicle arrival and movement models, mixed traffic flow simulation, Simulation model development strategies.

Fundamentals of traffic simulation modeling. Simulation methodologies and model design. Simulation languages, Study of large-scale simulation models.

Recommended Readings

Text /Reference books:-

1. Human Behavior and Traffic Networks: Schreckenberg and Selten
2. Modelling and Simulation: Exploring Dynamic System Behavior: Birta and Arbez
3. Banks, J; Carson, JS; Nelson, B.L. Discrete-event system simulation. 5th ed. Upper
4. Saddle River, NJ: Prentice-Hall, 2010.
5. Barceló, J. "Models, Traffic Models, Simulation, and Traffic Simulation". Barceló, J. ed. Fundamentals of traffic simulation. New York: Springer, 2010.
6. Boris S. Kerner, Introduction to Modern Traffic Flow Theory and Control, Springer; 1st Edition. Edition, 2009
7. Fred L. Mannering, Scott S. Washburn, Kilareski Walter P., Principles Of Highway Engineering And Traffic Analysis, Wiley India Pvt Ltd., 4th edition, 2011.
8. Highway Capacity Manual, Transportation Research Board, Washington, D.C., 2010.

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Center	**:**	**Department of Civil Engineering**
M.Tech.	**:**	**Transportation Engineering**
Course Code	**:**	**21CET841**
Course Name	**:**	**Urban Transportation System**
Credits	**:**	**3 L - 3 T - 0 P - 0**
Course Type	**:**	**Elective**
Prerequisites	**:**	**None**

COURSE OUTCOMES

CO1: Gain knowledge of urban transportation planning to resolve the current issues in the urban areas related to transportation system

CO2: Analyse and ability to understand various land use models & their evaluation.

CO3: Ability to understand transportation impact study methodologies.

CO4: An ability to understand & evaluate alternative transportation plans, develop concepts and implementation.

COURSE CONTENTS

Dimensions of the widening role of urban transportation system planning; the planning processLand use and transport system models; comparison and evaluation of various models Transportation impact study methodologies;

Strategies for the evaluation of alternative transportation plans and plan implementation; regional analysis and development concepts;

The role of transportation planning in the overall regional system; methodology and models for regional transportation system planning; implementation framework and case studies.

Recommended Readings

Text /Reference books:-

2. Tiwari G., Urban Transport for Growing Cities – High Capacity Bus System,MacMillan India Ltd., 2002.
3. Black, A, Urban Mass Transportation Planning, McGraw-Hill International Enterprises, Inc. 1995.
4. David A. Hensher, Bus Transport: Economics, Policy and Planning. Research in Transportation Economics Volume 18. Elsevier Publications, 2007.
5. National Urban Transport Policy, Ministry of Urban Development, Government of India, New Delhi, 2006.
6. Kenneth A. Small and Erik T. Verhoef, Urban Transportation Economics, 2nd Edition, Routledge, London, 2007.
7. Simpson, Barry J., Urban Public Transport Today. Taylor & Francis Routledge Publisher, 2003.
8. VuchicVukan R., Urban Transit: Operations, Planning and Economics, Prentice Hall, 2005.

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Department/Center	**:**	**Department of Civil Engineering**
M.Tech.	**:**	**Transportation Engineering**
Course Code	**:**	**21CES662**
Course Name	**:**	**Seminar**
Credits	**:**	**4 L - 0 T - 0 P - 8**
Course Type	**:**	**Core**

COURSE OUTCOMES

CO1: An ability to collect, Analyse and present, state of art information on any transportation engineering problem

CO2: An ability to evaluate various case studies from across the world to choose possible solutions for specific problems related to transportation engineering.

CO3: An ability to effectively communicate with the help of report, presentation, charts, figures etc. the main findings of her/his study

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Department/Center	**:**	**Department of Civil Engineering**
M.Tech.	**:**	**Transportation Engineering**
Course Code	**:**	**21CED661, 21CED663**
Course Name	**:**	**Dissertation**
Credits	**:**	**8 + 12 = 20 L - 0 T - 0 P - 40**
Course Type	**:**	**CORE**

COURSE OUTCOMES

CO1: An ability to formulate, develop methodology, collect required data, experiment results for any transportation engineering problem.
CO2: An ability to independently use latest engineering tools, equipment's, software or algorithms for finding solutions of transportation engineering problem.
CO3: An ability to effectively communicate with the help of report, presentation, charts, figures etc. the main findings of her/his study